IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BOARD OF PATENT APPEALS AND INTERFERENCES

In re patent application of:
Lu, et al. | Atty. Docket No.: FIS920030308US1

Serial No.: 10/708,748 | Group Art Unit: 2881

Filed: March 23, 2004 | Examiner: Johnston, Phillip A.

For: PT COATING INITIATED BY INDIRECT ELECTRON BEAM FOR RESIST CONTACT HOLE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPELLANTS' APPEAL BRIEF

Sirs:

Appellant respectfully appeals the final rejection of claims 1-3, 6-8, 10-, 13-15, 17, and 19-20, in the Office Action dated August 23, 2007. A Notice of Appeal was timely filed on November 23, 2007.

I. REAL PARTY IN INTEREST

The real party in interest is International Business Machines Corporation, Armonk, New York, assignee of 100% interest of the above-referenced patent application.

II. RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences known to Appellants, Appellants' legal representative or Assignee which would directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

III. STATUS OF CLAIMS

Claims 1-3, 6-8, 10, 13-15, 17, and 19-20 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Fuji (U.S. Patent No. 5,574,280), in view of Kadyshevitch (U.S. Publication No. 2004/0021076). None of the claims are allowed; all of the rejections are appealed.

IV. STATUS OF AMENDMENTS

In response to the Office Action mailed August 23, 2007 (referred to herein as the "Office Action"), Appellants filed an after-final Amendment on October 18, 2007. An Advisory Action mailed on October 29, 2007 indicated that Applicants' amendments would not be entered. The claims shown in the appendix are shown in their form as of the most recently entered Amendment dated June 5, 2007.

V. SUMMARY OF CLAIMED SUBJECT MATTER

One feature of the invention is a method of inspecting topographical features of the top layer of a structure. Claim 1 defines this feature as follows: "A method of inspecting topographical features of the top layer of a structure." This feature is described at various points in the specification, for example paragraph [0026] describes this feature as follows: As shown in FIG. 2, the invention provides a method of

inspecting topographical features, such as vias 104, of the top layer 102 of a partially completed structure 100 (e.g., integrated circuit). This is shown in Figure 2.

Another feature of the invention is surrounding the structure with a precursor metal gas. Claim 1 defines this feature as follows: "surrounding said structure with a precursor metal gas." This feature is described at various points in the specification, for example paragraph [0027] describes this feature as follows: "the invention surrounds the partially completed integrated circuit structure 100 with a precursor organic metal gas 108 and then directs an angled electron beam 110, from an ion beam generator 46, to the partially completed integrated circuit structure 100 to create secondary electron beams 604 (shown in FIG. 6) as the angled electron beam 110 strikes the sidewalls of the vias 104." This is shown in Figure 6.

Another feature of the invention is directing an angled electron beam at the structure where an angle of the angled beam is selected to create secondary electron beams as the angled electron beam strikes sidewalls of the topographical features, comprising directing the electron beam at an angle sufficient to cause the electron beam to strike the sidewalls of the topographical features and prevent the electron beam from reaching the bottom of the topographical features, wherein the secondary beams have less energy than said angled electron beam, and wherein the secondary electron beams break down the precursor metal gas to form a metal coating on the structure. Claim 1 defines this feature as follows: "directing an angled electron beam at said structure where an angle of said angled beam is selected to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features, comprising directing said electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said topographical features and prevent said electron beam from reaching the bottom of said topographical features, wherein said secondary beams have less energy than said angled electron beam, and wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said structure." This feature is described at various points in the specification, for example paragraph [0029] describes this feature as follows: " The secondary electron beams 604 have much less energy than the angled

electron beam 110 and the angled electron beam 110 has an energy level of approximately between 100 and 10,000 electron volts. The process of directing the angled electron beam 110 comprises directing the electron beam 110 at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of the partially completed integrated circuit structure 100." This is shown in Figure 5.

Another feature of the invention is directing an ion beam at the structure to form a groove within the top layer of the structure, wherein the metal coating is adapted to protect the topographical features from the ion beam. Claim 1 defines this feature as follows: "directing an ion beam at said structure to form a groove within said top layer of said structure, wherein said metal coating is adapted to protect said topographical features from said ion beam." This feature is described at various points in the specification, for example paragraph [0028] describes this feature as follows: "After the protective metal layer 112 is formed (as shown in FIGS. 4 and 5) the invention directs an ion beam 20 from an ion beam generator 18 at the partially completed integrated circuit structure 100 to form a groove 114 within the top layer 102." This is shown in Figures 4 and 5.

Another feature of the invention is inspecting the topographical features exposed by the groove in the top layer of the structure. Claim 1 defines this feature as follows: "inspecting said topographical features exposed by said groove in said top layer of said structure." This feature is described at various points in the specification, for example paragraph [0028] describes this feature as follows: "This allows inspection of cross sections of the vias 104 exposed by the groove 114, as shown in FIG. 5." This is shown in Figure 5.

Another feature of the invention is a method of inspecting topographical features of the top layer of a partially completed integrated circuit structure. Claim 8 defines this feature as follows: "A method of inspecting topographical features of the top layer of a partially completed integrated circuit structure." This feature is described at various points in the specification, for example paragraph [0026] describes this feature as follows: "As shown in FIG. 2, the invention provides a method of inspecting

topographical features, such as vias 104, of the top layer 102 of a partially completed structure 100 (e.g., integrated circuit)." This is shown in Figure 2.

Another feature of the invention is surrounding the partially completed integrated circuit structure with a precursor organic metal gas. Claim 8 defines this feature as follows: "surrounding said partially completed integrated circuit structure with a precursor organic metal gas." This feature is described at various points in the specification, for example paragraph [0027] describes this feature as follows: "the invention surrounds the partially completed integrated circuit structure 100 with a precursor organic metal gas 108 and then directs an angled electron beam 110, from an ion beam generator 46, to the partially completed integrated circuit structure 100 to create secondary electron beams 604 (shown in FIG. 6) as the angled electron beam 110 strikes the sidewalls of the vias 104." This is shown in Figure 6.

Another feature of the invention is directing an angled electron beam at the partially completed integrated circuit structure where an angle of the angled beam is selected to create secondary electron beams as the angled electron beam strikes sidewalls of the topographical features, comprising directing the electron beam at an angle sufficient to cause the electron beam to strike the sidewalls of the topographical features and prevent the electron beam from reaching the bottom of the topographical features, wherein the secondary beams have less energy than the angled electron beam, and wherein the secondary electron beams break down the precursor metal gas to form a metal coating on the partially completed integrated circuit structure. Claim 8 defines this feature as follows: "directing an angled electron beam at said partially completed integrated circuit structure where an angle of said angled beam is selected to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features, comprising directing said electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said topographical features and prevent said electron beam from reaching the bottom of said topographical features, wherein said secondary beams have less energy than said angled electron beam, and wherein said secondary electron beams break down said precursor metal gas to form a metal coating

on said partially completed integrated circuit structure." This feature is described at various points in the specification, for example paragraph [0029] describes this feature as follows: " The secondary electron beams 604 have much less energy than the angled electron beam 110 and the angled electron beam 110 has an energy level of approximately between 100 and 10,000 electron volts. The process of directing the angled electron beam 110 comprises directing the electron beam 110 at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of the partially completed integrated circuit structure 100." This is shown in Figure 5.

Another feature of the invention is directing an ion beam at the partially completed integrated circuit structure to form a groove within the top layer of the partially completed integrated circuit structure, wherein the metal coating is adapted to protect the topographical features from the ion beam. Claim 8 defines this feature as follows: "directing an ion beam at said partially completed integrated circuit structure to form a groove within said top layer of said partially completed integrated circuit structure, wherein said metal coating is adapted to protect said topographical features from said ion beam." This feature is described at various points in the specification, for example paragraph [0028] describes this feature as follows: "After the protective metal layer 112 is formed (as shown in FIGS. 4 and 5) the invention directs an ion beam 20 from an ion beam generator 18 at the partially completed integrated circuit structure 100 to form a groove 114 within the top layer 102." This is shown in Figures 4 and 5.

Another feature of the invention is inspecting cross sections of the topographical features exposed by the groove in the top layer of the partially completed integrated circuit structure. Claim 8 defines this feature as follows: "inspecting cross sections of said topographical features exposed by said groove in said top layer of said partially completed integrated circuit structure." This feature is described at various points in the specification, for example paragraph [0028] describes this feature as follows: "This allows inspection of cross sections of the vias 104 exposed by the groove 114, as shown in FIG. 5." This is shown in Figure 5.

Another feature of the invention is a method of inspecting vias of the top layer of a partially completed integrated circuit structure. Claim 15 defines this feature as follows: "A method of inspecting vias of the top layer of a partially completed integrated circuit structure." This feature is described at various points in the specification, for example paragraph [0026] describes this feature as follows: "As shown in FIG. 2, the invention provides a method of inspecting topographical features, such as vias 104, of the top layer 102 of a partially completed structure 100 (e.g., integrated circuit)." This is shown in Figure 2.

Another feature of the invention is surrounding the partially completed integrated circuit structure with a precursor organic metal gas. Claim 15 defines this feature as follows: "surrounding said partially completed integrated circuit structure with a precursor organic metal gas." This feature is described at various points in the specification, for example paragraph [0027] describes this feature as follows: "the invention surrounds the partially completed integrated circuit structure 100 with a precursor organic metal gas 108 and then directs an angled electron beam 110, from an ion beam generator 46, to the partially completed integrated circuit structure 100 to create secondary electron beams 604 (shown in FIG. 6) as the angled electron beam 110 strikes the sidewalls of the vias 104." This is shown in Figure 6.

Another feature of the invention is directing an angled electron beam at the partially completed integrated circuit structure where an angle of the angled beam is selected to create secondary electron beams as the angled electron beam strikes the sidewalls of the vias, comprising directing the electron beam at an angle sufficient to cause the electron beam to strike the sidewalls of the vias and prevent the electron beam from reaching the bottom of the vias, wherein the secondary beams have less energy than the angled electron beam, and wherein the secondary electron beams break down the precursor metal gas to form a metal coating on the partially completed integrated circuit structure. Claim 15 defines this feature as follows: "directing an angled electron beam at said partially completed integrated circuit structure where an angle of said angled beam is selected to create secondary electron beams as said angled electron beam strikes the

sidewalls of said vias, comprising directing said electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said vias and prevent said electron beam from reaching the bottom of said vias, wherein said secondary beams have less energy than said angled electron beam, and wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said partially completed integrated circuit structure." This feature is described at various points in the specification, for example paragraph [0029] describes this feature as follows: " The secondary electron beams 604 have much less energy than the angled electron beam 110 and the angled electron beam 110 has an energy level of approximately between 100 and 10,000 electron volts. The process of directing the angled electron beam 110 comprises directing the electron beam 110 at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of the partially completed integrated circuit structure 100." This is shown in Figure 5.

Another feature of the invention is directing an ion beam at the partially completed integrated circuit structure to form a groove within the top layer of the partially completed integrated circuit structure, wherein the metal coating is adapted to protect the vias from the ion beam. Claim 15 defines this feature as follows: "directing an ion beam at said partially completed integrated circuit structure to form a groove within said top layer of said partially completed integrated circuit structure, wherein said metal coating is adapted to protect said vias from said ion beam." This feature is described at various points in the specification, for example paragraph [0028] describes this feature as follows: "After the protective metal layer 112 is formed (as shown in FIGS. 4 and 5) the invention directs an ion beam 20 from an ion beam generator 18 at the partially completed integrated circuit structure 100 to form a groove 114 within the top layer 102." This is shown in Figures 4 and 5.

Another feature of the invention is inspecting cross sections of the vias exposed by the groove in the top layer of the partially completed integrated circuit structure. Claim 15 defines this feature as follows: "inspecting cross sections of said vias exposed by said groove in said top layer of said partially completed integrated circuit structure."

This feature is described at various points in the specification, for example paragraph [0028] describes this feature as follows: "This allows inspection of cross sections of the vias 104 exposed by the groove 114, as shown in FIG. 5." This is shown in Figure 5.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The issues presented for review is whether claims 1-3, 6-8, 10, 13-15, 17, and 19-20 are unpatentable under 35 U.S.C. §103(a) by Fuji in view of Kadyshevitch.

VII. ARGUMENT

A. The Rejection Based on Fuji in view of Kadyshevitch

1. The Position in the Office Action

The Office Action states:

Claims 1-3, 6-8,10,13-15,17,19, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over USPN 5,574,280 to Fuji, in view of Kadyshevitch, U.S. Pat. Pub. No. 2004/0021076.

Regarding claims 1, 8, and 15, Fuji teaches a method of inspecting topographical features of the top layer of a structure, said method comprising:

surrounding said structure with a precursor metal gas; directing an angled electron beam at said structure, wherein said secondary beams have less energy than said angled electron beam, and wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said structure; directing an ion beam at said structure to form a groove within said top layer of said structure, wherein said metal coating is adapted to protect said topographical features from said ion beam; and inspecting said topographical features exposed by said groove in said top layer of said structure. Column 2, line 40-49; Column 4, line 34-45; Column 5, line 47-57; and Figure 4 below.

Fuji uses an angled electron beam 19 to irradiate an organic metal gas blown by gas source 14 onto the surface of semiconductor device 5, forming a hard protective metal film on the surface by the CVD (dissociation by secondary electrons) process. A

portion of the sample 5 at the predetermined area is removed by ion beam sputtering (forms a groove), exposing the cross-section of the semiconductor, which is then imaged on display 7 (for inspecting the exposed area).

Fuji fails to teach directing an angled electron beam at the structure above, where an angle of said angled beam is selected to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features, comprising directing said electron beam at an angle sufficient to cause said electron
FIG. 6 beam to strike the sidewalls of said topographical features and prevent said electron beam from reaching the bottom of said topographical features.

Kadyshevitch teaches angled irradiation of contact hole 26 by an electron beam 130, where the tilt angle of beam 130 is preferably chosen so that a majority of primary beam electrons do not strike the bottom of the contact hole. See [01981 and Figure 11 below.

Kadyshevitch modifies the Fuji method to provide a particle beam that radiates the surface of the sample at a non-normal angle, so that, the energetic primary beam strikes the side walls of the contact holes, rather than the bottom, and since the sec9ticta~_eiectrons~ernitted from-1heside walls and upper edge of the contact holes are driven down toward the bottom of the werethey will have less effect on the bottom Sulce they are substantially less energetic than the electrons in the primary beam.

Therefore it would have been obvious to one of ordinary skill in the art that Fuji would use an angled electron beam so that more of the charged particles strike the side walls than strike the bottom of the contact hole.

Regarding claims 2, 3, 7, 10, 14, 17, and 20, Fuji as described above regarding claims 1, 8, and 15, teaches directing said angled electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said topographical features, and comprises tilting a stage that at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of said structure (Note also Figure 6b in Fuji).

Regarding claim 6, 13, and 19, the use of an electron beam having an energy level of approximately between 100 and 10,000 electron volts is well known in the art.

2. Appellants' Position

a. Independent Claims 1, 8, and 15

Appellants traverse the rejections because the claimed invention creates secondary electron beams that "break down said precursor metal gas to form a metal coating" (independent claims 1, 8, 15), whereas the secondary electrons of Kadyshevitch "are driven down toward the bottom of the holes" so that they are not free to react with precursor gas to form a metal coating.

The Office Action expressly acknowledges that "Fuji fails to teach directing an angled electron beam at the structure … where an angle of said angled beam is selected to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features, comprising directing said electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said topographical features and prevent said electron beam from reaching the bottom of said topographical features" (Office Action, pp. 3-4, item 6) (independent claims 1, 8, 15).

However, the Office Action asserts that Kadyshevitch teaches an angled electron beam 130, wherein "the tilt angle of beam 130 is preferably chosen so that a majority of *primary* beam electrons do not strike the bottom of the contact hole" (Office Action, p. 4, item 7 (emphasis added)). Nevertheless, Appellants submit that the proposed combination of Fuji and Kadyshevitch would not have resulted in the claimed invention because the primary electron beam of Kadyshevitch does not create secondary electron beams that "break down said precursor metal gas to form a metal coating" (independent claims 1, 8, 15). Instead, the secondary electrons of Kadyshevitch are directed to the bottom of the holes after striking side walls of contact holes and are not free to react with any precursor gas.

Nothing within Kadyshevitch mentions secondary electron beams that "break down said precursor metal gas to form a metal coating" (independent claims 1, 8, 15). Instead, Kadyshevitch only discloses the use of secondary electron beams to "provide a more sensitive indicator of etch state" in a specimen.

More specifically, as described in paragraph 0017 of Kadyshevitch, test configurations are used to enhance the strength or sensitivity of the etch indicator signal for a given particle beam current and contact hole size. These test configurations are useful in particular to enhance sensitivity to very thin layers or remaining dielectric at the bottom of the contact hole. In one of these embodiments, the particle beam irradiates the surface of the sample at a non-normal angle, i.e., with at least a slight tilt. As a result, the energetic primary beam strikes the side walls of the contact holes, rather than the bottom. The surface of the sample is negatively precharged, so that **secondary electrons** emitted from the side walls and upper edge of the contact holes **are driven down toward the bottom of the holes**. The secondary electrons, however, are substantially less energetic than the electrons in the primary beam. Therefore, the secondary electrons are less able than the primary electrons to penetrate through thin residue layers that may remain at the bottom of the contact holes. As a result, the measurement of specimen current using an angled particle beam can, under some conditions, provide a more sensitive indicator of etch state than can be achieved using a conventional, normal-incidence beam.

As further described in paragraph 0200 of Kadyshevitch, **the secondary electrons can be forced down to the hole bottom, rather than moving out of the hole**, by negatively precharging a surface 132 of the wafer around the hole. If the contact hole is etched properly (with no residue left at the bottom), the low-energy electron flow will **pass through substrate 28** and will thus be measured as a specimen current by ammeter 48.

Because the "secondary electrons can be forced down to the hole bottom, rather than moving out of the hole" (Kadyshevitch, para. 0200), they are not free to react with any precursor gas (such as that in Fuji) to form any metal coating. Therefore, Appellants submit that Kadyshevitch teaches away from the claimed invention.

To the contrary, as described in paragraph 0027 of Appellants' disclosure and defined by independent claims 1, 8, and 15, the invention surrounds the partially completed integrated circuit structure 100 with a precursor organic metal gas 108 and then directs an angled electron beam 110, from an ion beam generator 46, to the partially

completed integrated circuit structure 100 to create secondary electron beams 604 (shown in FIG. 6) as the angled electron beam 110 strikes the sidewalls of the vias 104. The process of directing the angled electron beam can be performed for example, by tilting the stage 26 that supports the partially completed integrated circuit structure 100.

As further described in paragraph 0028 of Appellants' disclosure and defined by independent claims 1, 8, and 15, the secondary electron beams 604 break down the precursor metal gas to form a metal coating 112, without damaging the top layer 102 (or underlying layers 100). This process directs the electron beam 110 at an angle sufficient to cause the electron beam 110 to strike only the sidewalls of the vias 104 and prevent the electron beam 110 from reaching the bottom of the vias 104, so as to not damage the vias 104 during the metal formation process. The primary electron beam 110 does not substantially affect the sidewalls of features and can readily be directed at such sidewalls. Instead, the primary beam should be kept away from the bottom and lower level features, such as the ARC, to prevent damaging such lower level substances.

Accordingly, Appellants submit that because the secondary electrons of Kadyshevitch "secondary electrons can be forced down to the hole bottom, rather than moving out of the hole", they are not free to react with any precursor gas to form any metal coating. Therefore, it is Appellants' position that the proposed combination of Kadyshevitch and Fuji does not teach or suggest the claimed features of directing said electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said topographical features and prevent said electron beam from reaching the bottom of said topographical features, wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said structure as defined in independent claims 1, 8, and 15. In view the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

b. Dependent Claims 6, 13, and 19

Appellants traverse the rejections because the prior art of record fails to teach or suggest the claimed features "wherein said process of directing said angled electron beam

comprises using an electron beam having an energy level of approximately between 100 and 10,000 electron volts" as defined in dependent claims 6, 13, and 19.

On page 5, item 11 of the Office Action, the Office Action asserts that the use of an electron beam having an energy level of approximately between 100 and 10,000 electron volts is "well known in the art". Appellants respectfully disagree and submit that the Office Action fails to provide any support or present any prior art references illustrating an electron beam having an energy level of approximately between 100 and 10,000 electron volts as defined in dependent claims 6, 13, and 19.

Instead, the Office Action only presents two prior art references (i.e., Kadyshevitch and Fuji) that fail to disclose the voltage applied to the electron beam. More specifically, Kadyshevitch merely discloses that an electron beam 61 irradiates the area of contact holes 26. A beam blanking assembly 59 periodically applies a voltage V_{BB} in order to pulse the electron beam on and off (Kadyshevitch, para. 0168). Nevertheless, Kadyshevitch fails to disclose the magnitude of the "voltage V_{BB}". Moreover, Fuji only discloses an "ion beam 11 having high energy" (Fuji, col. 1, line 40). However, Fuji fails to define "high energy". To the contrary, as described in paragraph 0029 of Appellants' disclosure, the secondary electron beams 604 have much less energy than the angled electron beam 110 and the angled electron beam 110 has an energy level of approximately between 100 and 10,000 electron volts.

Accordingly, Appellants submit that the prior art of record fails to teach or suggest the claimed features "wherein said process of directing said angled electron beam comprises using an electron beam having an energy level of approximately between 100 and 10,000 electron volts" as defined in dependent claims 6, 13, and 19. In view the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

c. Dependent Claim 7

Appellants traverse the rejections because the prior art of record fails to teach or suggest the claimed features "wherein said process of directing said angled electron beam comprises directing said electron beam at an angle between approximately 20 and 70

degrees with respect to the surface of the top layer of said structure" as defined in dependent claim 7.

On page 5, item 11 of the Office Action, the Office Action asserts that such features are shown in FIG. 6B of Fuji. Appellants respectfully disagree and submit that nothing within Fuji, including FIG. 6B, discloses "directing said electron beam at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of said structure" (dependent claim 7). Instead, as illustrated in FIG. 6B of Fuji, the "irradiation unit 3" is at a 90 degree angle with respect to the "Si substrate 36".

Furthermore, Kadyshevitch fails to disclose an electron beam angled between approximately 20 and 70 degrees with respect to the surface of the top layer of the structure. Instead, Kadyshevitch merely discloses that "the particle beam irradiates the surface of the sample at a non-normal angle, i.e., with at least a slight tilt" (Kadyshevitch, para. 0017). Nevertheless, nothing within Kadyshevitch discloses that the "slight tilt" can be between 20 and 70 degrees.

Accordingly, Appellants submit that the prior art of record fails to teach or suggest the claimed features "wherein said process of directing said angled electron beam comprises directing said electron beam at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of said structure" as defined in dependent claim 7. In view the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

d. Dependent Claims 14 and 20

Appellants traverse the rejections because the prior art of record fails to teach or suggest the claimed features "wherein said process of directing said angled electron beam comprises directing said electron beam at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of said partially completed integrated circuit structure" as defined in dependent claims 14 and 20.

On page 5, item 11 of the Office Action, the Office Action asserts that such features are shown in FIG. 6B of Fuji. Appellants respectfully disagree and submit that

nothing within Fuji, including FIG. 6B, discloses "directing said electron beam at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of said partially completed integrated circuit structure" (dependent claims 14 and 20). Instead, as illustrated in FIG. 6B of Fuji, the "irradiation unit 3" is at a 90 degree angle with respect to the "Si substrate 36".

Furthermore, Kadyshevitch fails to disclose an electron beam angled between approximately 20 and 70 degrees with respect to the surface of the top layer of the partially completed integrated circuit structure. Instead, Kadyshevitch merely discloses that "the particle beam irradiates the surface of the sample at a non-normal angle, i.e., with at least a slight tilt" (Kadyshevitch, para. 0017). Nevertheless, nothing within Kadyshevitch discloses that the "slight tilt" can be between 20 and 70 degrees.

Accordingly, Appellants submit that the prior art of record fails to teach or suggest the claimed features "wherein said process of directing said angled electron beam comprises directing said electron beam at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of said partially completed integrated circuit structure" as defined in dependent claims 14 and 20. In view the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

e. Dependent Claims 2-3, 10, and 17

It is Appellants' position that the proposed combination of Kadyshevitch and Fuji does not render obvious independent claims 1, 8, and 15 and similarly does not render obvious dependent claims 2-3, 10, and 17. In view the foregoing, the Board is respectfully requested to reconsider and withdraw this rejection.

B. CONCLUSION

In view the forgoing, the Board is respectfully requested to reconsider and withdraw the rejections of claims 1-3, 6-8, 10, 13-15, 17, and 19-20.

Please charge any deficiencies and credit any overpayments to Attorney's Deposit Account Number 09-0458.

Respectfully submitted,

Date: January 18, 2008

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IX. CLAIMS APPENDIX

1. A method of inspecting topographical features of the top layer of a structure, said method comprising:

surrounding said structure with a precursor metal gas;

directing an angled electron beam at said structure where an angle of said angled beam is selected to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features, comprising directing said electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said topographical features and prevent said electron beam from reaching the bottom of said topographical features, wherein said secondary beams have less energy than said angled electron beam, and wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said structure;

directing an ion beam at said structure to form a groove within said top layer of said structure, wherein said metal coating is adapted to protect said topographical features from said ion beam; and

inspecting said topographical features exposed by said groove in said top layer of said structure.

2. The method in claim 1, wherein said process of directing said angled electron beam directs said electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said topographical features.

3. The method in claim 1, wherein said process of directing said angled electron beam comprises tilting a stage that supports said structure.

4-5. (Canceled).

6. The method in claim 1, wherein said process of directing said angled electron beam comprises using an electron beam having an energy level of approximately between 100 and 10,000 electron volts.

7. The method in claim 1, wherein said process of directing said angled electron beam comprises directing said electron beam at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of said structure.

8. A method of inspecting topographical features of the top layer of a partially completed integrated circuit structure, said method comprising:

surrounding said partially completed integrated circuit structure with a precursor organic metal gas;

directing an angled electron beam at said partially completed integrated circuit structure where an angle of said angled beam is selected to create secondary electron beams as said angled electron beam strikes sidewalls of said topographical features, comprising directing said electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said topographical features and prevent said electron beam from reaching the bottom of said topographical features, wherein said secondary beams have less energy than said angled electron beam, and wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said partially completed integrated circuit structure;

directing an ion beam at said partially completed integrated circuit structure to form a groove within said top layer of said partially completed integrated circuit structure, wherein said metal coating is adapted to protect said topographical features from said ion beam; and

inspecting cross sections of said topographical features exposed by said groove in said top layer of said partially completed integrated circuit structure.

9. (Cancelled).

10. The method in claim 8, wherein said process of directing said angled electron beam comprises tilting a stage that supports said partially completed integrated circuit structure.

11-12. (Canceled).

13. The method in claim 8, wherein said process of directing said angled electron beam comprises using an electron beam having an energy level of approximately between 100 and 10,000 electron volts.

14. The method in claim 8, wherein said process of directing said angled electron beam comprises directing said electron beam at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of said partially completed integrated circuit structure.

15. A method of inspecting vias of the top layer of a partially completed integrated circuit structure, said method comprising:

surrounding said partially completed integrated circuit structure with a precursor organic metal gas;

directing an angled electron beam at said partially completed integrated circuit structure where an angle of said angled beam is selected to create secondary electron beams as said angled electron beam strikes the sidewalls of said vias, comprising directing said electron beam at an angle sufficient to cause said electron beam to strike the sidewalls of said vias and prevent said electron beam from reaching the bottom of said vias, wherein said secondary beams have less energy than said angled electron beam, and wherein said secondary electron beams break down said precursor metal gas to form a metal coating on said partially completed integrated circuit structure;

directing an ion beam at said partially completed integrated circuit structure to form a groove within said top layer of said partially completed integrated circuit structure, wherein said metal coating is adapted to protect said vias from said ion beam; and

inspecting cross sections of said vias exposed by said groove in said top layer of said partially completed integrated circuit structure.

16. (Cancelled).

17. The method in claim 15, wherein said process of directing said angled electron beam comprises tilting a stage that supports said partially integrated circuit structure.

18. (Cancelled).

19. The method in claim 15, wherein said process of directing said angled electron beam comprises using an electron beam having an energy level of approximately between 100 and 10,000 electron volts.

20. The method in claim 15, wherein said process of directing said angled electron beam comprises directing said electron beam at an angle between approximately 20 and 70 degrees with respect to the surface of the top layer of said partially completed integrated circuit structure.

X. EVIDENCE APPENDIX

There is no other evidence known to Appellants, Appellants' legal representative or Assignee which would directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

XI. RELATED PROCEEDINGS APPENDIX

There is no other related proceedings known to Appellants, Appellants' legal representative or Assignee which would directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.